THE SUGGESTIVE INFLUENCE OF LINEUPS ON MEMORY: A COMPARATIVE STUDY OF CHILDREN AND ADULTS

by
Caisa Elizabeth Royer

A thesis submitted to the faculty of
Cornell University
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

Human Development
Cornell University
August, 2014

ABSTRACT

This study was designed to test whether making a selection from a target-absent lineup could alter memory for the actual perpetrator. Three different lineup presentations were used: simultaneous, sequential, and elimination. In addition, three different memory tests were used in which participants saw two of the following three faces: the actual thief, a suspect from the original lineup, and a novel suspect. The sequential lineup resulted in the fewest initial false identifications, while the simultaneous lineup appeared to protect the most against memory alteration. Logistic regression models were utilized to estimate the likelihood of making a particular identification during the memory test. Participants were more likely to identify the innocent original suspect when they were older, non-white, and were shown the sequential lineup. Participants were more likely to make an accurate identification of the thief when they were younger and had made an identification from the initial lineup.

BIOGRAPHICAL SKETCH

Caisa Elizabeth Royer was born and raised in Lincoln, Nebraska. She received her Bachelor of Science in Psychology and Criminal Justice in 2012 from Iowa State University in Ames, Iowa. She graduated *magna cum laude* and with Honors. As an undergraduate, she worked in multiple psychology laboratories and was inspired to study the intersect of psychology and legal decision making. She is currently a Ph.D./J.D. student at Cornell University pursuing a degree with a concentration in Law, Psychology, and Human Development. She is a member of Dr. Stephen Ceci's Child Witness and Cognition Laboratory.

ACKNOWLEDGEMENTS

I would like to thank Dr. Stephen J. Ceci for his mentorship, guidance, and support throughout this project. I would also like to thank Dr. Valerie P. Hans and Dr. David Dunning for sharing their knowledge and constructive feedback.

This project would not have been possible without the help of a number of important people. I am especially grateful to Amelia Courtney Hritz, for her invaluable help and assistance on this project and many others. Thank you as well to Kayla Burd, Logan Kenney, Grace Monks, Jonathan Lash, James Dunlea, Ana Padilla, and Victoria Dahl for their time, good nature, and creativity while collecting participants and working the kinks out of this project. It was a joy to work so closely with all of you. I am also grateful to Priscila Brust Renck, Evan Wilhelms, and Andy Jefferson for lending their extensive talents to the development of the stimulus. Thank you as well to Rebecca Helm and Karen Ojeda for their feedback and ideas during development of this project.

Thank you to the Sciencenter in Ithaca, NY, and for allowing us to run this study and many others on the floor of their museum. They have provided us with a remarkable opportunity, and I will be forever grateful for their encouragement of learning in both children and adults. Thank you as well to the Enfield Elementary School staff for being so accommodating and helpful.

Finally, I would like to thank Jeffrey Royer and RuthAnn Royer for everything and so much more.

TABLE OF CONTENTS

INTRODUCTION

Lineups are a prominent feature of police investigations and play an important role when helping eyewitnesses identify a perpetrator. The identification of a suspect by a witness is especially helpful when the police have little or no other evidence, and eyewitness testimony has been shown to be extremely influential during the course of a trial. However, research suggests that lineups can be problematic, with witnesses commonly identifying innocent people from a lineup (Cutler & Penrod, 1995; Wells, Small, & Penrod, 1998; Wells, 1993). In some situations a false identification made by a witness may not be an issue. For example, an eyewitness may identify a "filler" in the lineup who the police know is innocent. However, if the innocent person an eyewitness pinpoints is a viable suspect, this identification can affirm the police's suspicion and become important evidence during the trial, potentially leading to a false conviction.

Such false identifications may be of particular concern when the witness is a child. Some research suggests that child witnesses make correct identifications at the same rate as adults when the perpetrator is present in a lineup (Dekle, Beal, Elliot, & Huneycutt, 1996; Pozzulo & Lindsay, 1998; Goodman and Reed, 1986; Marin, Holmes, Guth, and Kovac, 1979; Parker and Carranza, 1989; Parker & Ryan, 1993). However, when the real perpetrator is absent from the lineup, children are continually found to be more likely to make a false selection than an adult witness (Dekle et al., 1996; Pozzulo & Lindsay, 1998; Lindsay, Pozzulo, Craig, Lee, & Corber, 1997; Parker & Carranza, 1989; Parker & Ryan, 1993 Chance & Goldstein, 1984; Goodman and Reed, 1986; Parker and Carranza, 1989; Parker and Ryan, 1993). Children tend to make more overall selections from lineups than adults and have a greater tendency to guess when asked to make an identification (Pozzulo & Lindsay, 1998). This is true even if the child is cautioned that the perpetrator may not be present in the lineup.

This tendency to guess may cause issues beyond a greater number of false accusations. Even if the identified culprit is found to be innocent, it is possible that viewing and making a selection from a lineup can pollute a witness's memory for the actual perpetrator and thus permanently undermine that witness's ability to make a future correct identification. The alteration hypothesis of memory suggests that misinformation can be integrated into memory and permanently alter the true memory of an event (Loftus, 1979). This paper will examine whether choosing the wrong person from a lineup could irreparably change a witness's memory for the actual perpetrator and reduce the chance of making a correct identification later on. Furthermore, this paper will also look at whether age is an important factor in post-event memory alteration.

Memory Alteration, Source Misattribution, and Lineups

Evidence shows that eyewitness testimony can become compromised by exposure to misleading post-event suggestion (Ceci & Bruck, 1993; Loftus & Loftus, 1980; Loftus, Miller, & Burns, 1978). Through the influence of suggestive information, eyewitnesses can come to report events different from what they actually saw. For example, participants who were shown a video of an event and then told a verbal narrative with the inclusion of purposefully misleading statements later reported seeing things in the video that were only suggested to them (Loftus, 1979). Additionally, exposure to misleading and suggestive information has been found to lead to decreased accuracy on a forced choice recognition task (Loftus et al., 1978).

Not only does misleading information change behavior on recognition tasks, but participants can come to truly believe they remember seeing information that was only suggested to them, even when confronted with the true information (Zaragoza & Lane, 1994). It is possible that routine investigative techniques, such as viewing and making a selection from a lineup, may

act as misinformation that could irreparably harm a witness's memory for a crime without the witness's knowledge. If this is the case, choosing the wrong person from a lineup could eliminate the subsequent viability of witnesses and inhibit their ability to later recognize the real perpetrator.

One theory of why misinformation leads to decreased recall accuracy is referred to as the "memory alteration hypothesis." This hypothesis suggests post-event misinformation can become integrated into an already existing memory and the initial information can be altered or lost completely (Loftus & Loftus, 1980; Loftus, 1979). There are subtle variants of this hypothesis in regard to whether the impaired accuracy is due to complete loss of the original memory, due to retrieval interference, or due to social factors. These subtle variations are beyond the scope of this paper (for a review of the misinformation effect see Ayers & Reder, 1998). Results suggesting the existence of memory alteration have been found in many studies using post-event misinformation (Loftus, 1979; Loftus & Loftus, 1980; McCloskey & Zaragoza, 1985; Zaragoza & Lane, 1994).

For example, Sutherland and Hayne (2001) found that participants exposed to suggestive information and given a forced-choice recognition task were more likely to select the false, suggested choice than participants exposed to either neutral or correct post-event information. However, in this experiment, participants did not volunteer the misinformation spontaneously when asked open-ended questions about the event, suggesting that the misinformation was not fully integrated into their original memory. The lack of free recall of suggested information has led to disagreement about whether post-event suggestion actually overwrites the original memory for an event or if it instead simply "coexists" alongside the memory for the true event and makes the original information more difficult to retrieve (Zargoza & Lane, 1994).

Other hypotheses argue that misinformation may only affect participants who never truly encoded the initial event or already forgot the details of the event by the time the suggested information was introduced (Bowman & Zaragoza, 1989; McCloskey & Zaragoza, 1985). Source-monitoring errors may also play a role in the confusion between true and suggested information. When misinformation is particularly similar to memory for an event (e.g., a suspect in a lineup who looks a great deal like the actual perpetrator) participants have a more difficult time identifying the source of their memories (e.g., observation of the crime or observation of a police lineup; Lindsay & Johnson, 1989; Bowman & Zaragoza, 1989). Furthermore, the use of a source monitoring test designed to prompt participants to remember the true source of their memories has been found to greatly reduce the effect of suggestive information on participants' recall (Lindsay & Johnson, 1989).

Once again, child witnesses may be particularly susceptible to these effects. While all individuals can be influenced by source misattribution, research indicates that children may be especially prone to these errors (Ceci, Loftus, Leichtman, & Bruck, 1994). Research suggests that children are more likely than adults to confuse perceptually or semantically similar sources (Ceci & Bruck, 1995; Lindsay, Johnson & Kwon, 1991). This implies that children may have a more difficult time retrieving the source of their memory between a lineup and the crime

Furthermore, preschool aged children also find it more difficult to subsequently distinguish between actual and imagined behaviors (Ceci et al., 1994). This occurs both when they imagine committing an act or imagine someone else doing it, and has been shown to influence children as old as 9-years old (Ceci et al., 1994; Foley & Johnson, 1986; Lindsay & Johnson, 1989). As opposed to older children, young preschoolers have been shown to make more false assents after being told a story and asked to imagine that it actually happened to,

especially when interviewed multiple times by the same interviewer (Ceci et al., 1994; Leichtman & Ceci, 1995). If children find it more difficult to distinguish between real and imagined behaviors, they may have trouble understanding that a suspect they've identified from the lineup is different from the actual perpetrator, even if given instructions that the real perpetrator may be missing from the lineup.

Some research indicates that, even when best practices are used, the simple act of viewing the lineup has been found to inhibit memory even in adults. For example, in one study by Gorenstein and Ellsworth (1980), students witnessed an event performed by a confederate during a class. Then, half of the students were asked to immediately pick the confederate out from a target-absent lineup. The other half of the class served as a control group who did not make a choice from any lineup during the first session. Several days later, the entire class selected from a new lineup. The researchers found that participants who had made a prior choice were less accurate than participants in the control group. Additionally, participants who had made a prior choice selected the suspect they had previously chosen at rates higher than chance, suggesting their choosing behavior was influenced by the first lineup.

Research looking at the influence of prior lineup on memory again shows that children may be especially vulnerable witnesses. In a similar study that examined the effects of repeated lineups on memory for a perpetrator, Parker, Haverfield, and Baker-Thomas (1986) found that children were less stable witnesses than adults. Children were more likely to switch their answers between the first and second lineup, regardless of whether they moved to or away from a correct choice. Gorenstein and Ellsworth (1980) also found that adults were more stable witnesses than children. Other research has found that the presence of a no-choice option

significantly decreases the stability of adult participants to match that of children (Parker and Caranza, 1989).

Palmer, Brewer, and Weber (2012) utilized target-absent lineups to test whether an initial lineup of innocent foils (called a "blank" lineup, i.e. a known target-absent lineup; see Wells, 1984) could be used by investigators to eliminate unreliable witnesses. Their results indicated that participants who chose someone during the initial blank lineup were more likely to make no selection during a second lineup with different choices, compared to participants who did not make an initial choice and participants who were not shown an initial lineup. Furthermore, they found that participants who made an initial selection had worse memories for the culprit than other participants. This may suggest that a target-absent lineup could integrate new information into the memory of witnesses, but only if they identify someone from the lineup.

The question that follows is: if viewing a lineup decreases recognition accuracy for the real perpetrator, what practices can be utilized to protect the original memory? Research suggests that certain protocols by investigators can protect against these false memories, such as source monitoring tests and the inclusion of no-choice options (Lindsay & Johnson, 1989; Parker & Carranza, 1989). However, Zaragoza and Lane (1994) found that the presence or absence of a direct warning that misinformation could have been supplied to participants had no effect on recall accuracy. Some research indicates this is the case for child witnesses viewing a lineup. Instructions that the perpetrator may not be present alongside a no-choice option do not influence the number of correct identifications made by children (Parker & Ryan, 1993; Pozzulo & Lindsay, 1998). Thus, if best practices used by investigators cannot effectively protect against false memories, it is important to explore whether certain lineup presentations could be protective, both against false memories and false identifications for adults and children.

Types of Lineup Presentation

One common judgment distinction in eyewitness identification literature is the difference between relative and absolute judgments used to make selection decisions (Wells, 1984). If a relative judgment strategy is utilized, a witness will choose the suspect from a lineup who most closely resembles their memory or mental image of the perpetrator of the crime relative to the other members of the lineup. If an absolute judgment strategy is used, a witness will instead make a decision by comparing an individual lineup member to their memory of the perpetrator and make a selection only if there is a match. In eyewitness identification research, relative judgments have been criticized for leading to high rates of false identification (Lindsay, Pozzulo, Craig, Lee, & Cooper, 1997), while absolute judgments have been lauded for being a conservative judgment strategy that protects against false identifications (Palmer & Brewer, 2012). Participants who report using relative judgments are more likely to make false-positive selections than participants who use absolute judgments (Lindsay et al., 1997).

There are two main types of lineup presentations common in the literature. The first is the simultaneous lineup, in which all lineup members are viewed at one time. This type of lineup encourages the use of a relative judgment between suspects. The second main type of lineup presentation is sequential, in which each lineup member is viewed by the witness individually (that is, suspects are viewed one at a time). This may cause witnesses to shift from a relative judgment strategy to an absolute one as each face is viewed individually and should only be compared to the witness's mental image of the perpetrator (Steblay, Dysart, & Wells, 2011).

The sequential presentation has been found to occasionally be associated with fewer correct identifications in target-present lineups, but also greater correct rejections in target-absent lineups (for a review see Steblay et al., 2011; see also Lindsay et al., 1997; Parker & Ryan,

1993). The sequential lineup procedure has been recommended for its conservative approach which appears to reduce false identifications and thus protects against false convictions. Research suggests that sequential presentations encourage witnesses to use a more conservative and less biased approach (Palmer & Brewer, 2012). Furthermore, the probability of identifying a truly guilty suspect from a sequential lineup has been found to be higher than from a simultaneous lineup (Steblay et al., 2011).

However, sequential lineups may not be as successful for children, who are more likely to guess if they do not see the perpetrator and thus are more susceptible to false identifications when shown suspects one at a time (Steblay et al, 2011; Lindsay et al., 1997). Children have also been shown to make more mistaken multiple identifications of lineup members in sequential lineups than adults (Lindsay et al., 1997). Their tendency to guess may be exacerbated by the sequential presentation, but their tendency towards false identifications is high for both simultaneous and sequential lineup presentation styles (Parker & Ryan, 1993, Pozzulo & Lindsay, 1998; Steblay et al., 2011).

In order to reduce the number of false selections made by children when choosing from target-absent lineups while also maintaining the level of accuracy when choosing from target-present lineups, a third lineup type was proposed by Pozzulo and Lindsay (1999). This procedure utilizes a two-judgment series of identifications. The witness is first asked to decide which member of the lineup looks the most similar to the perpetrator. This would be considered a relative judgment and would most likely lead to a selection of the perpetrator in a target-present lineup. Once a selection has been made, the non-identified suspects are "eliminated" from the lineup and the witness is asked to determine whether the remaining suspect is indeed the perpetrator. This would be an absolute judgment and would be expected to decrease false

identifications when viewing a target-absent lineup. During a regular simultaneous lineup, witnesses may perform the relative judgment by default and never make the absolute judgment. Children may be especially prone to this error (Beresford & Blades, 2006). The elimination presentation naturally encourages both judgments to be made.

The elimination method was designed particularly with child witnesses in mind. As mentioned previously, young children are more likely to make a selection from a lineup than adults. This may be because children are particularly susceptible to demands by adults or authority figures and may feel pressure to select someone from the lineup (Ceci, Toglia, & Ross, 1987). The elimination procedure allows children to comply with adult expectations to provide an answer, but still make an absolute negative judgment when necessary. Research suggests that the elimination presentation reduces the number of false-positive identifications while not lowering the number of correct identifications (Pozzulo & Lindsay, 1999; Pozzulo, Dempsey, Crescini, 2009). The elimination lineup presented along with instructions detailing the potential negative consequences of a false identification has been shown to reduce false positives made by children to the same level as adults viewing a simultaneous lineup (Pozzulo & Lindsay, 1999).

However, other researchers have found that the elimination technique, even with cautioning instructions, does not always lower the number of false identifications (Beresford & Blades, 2006). Furthermore, little research has looked at whether the elimination lineup procedure also improves accuracy in older children and adults. What research that has been done suggests that the beneficial effects of the elimination procedure do indeed extend to adults and reduce the number of false identifications while maintaining the level of correct identifications (Pozzulo & Balfour, 2006; Pozzulo, Dempsey, Corey, Girardi, & Lawandi, 2008). Pozzulo and colleagues (2008) found that both the elimination and sequential procedure reduced false

identification rates, while correct identification rates were stable across simultaneous, sequential, and elimination procedures.

In order to test the effect of lineups on false memories throughout different age ranges, it is important to test all three proposed lineup types. According to prior research, the elimination presentation should protect against false-selections in children, but it is also possible the two-step judgment process may also encourage false memories in witnesses by encouraging more time to be spent learning the face of the suspect. If the face of an innocent suspect is integrated into memory as a consequence of the process of the elimination comparison, it may make it more difficult for both children and adults to distinguish the source of their false memory. Witnesses who view an elimination procedure will spend more time studying the face of the suspect and may create a more intense memory for the suspect's face than witnesses who see either a simultaneous or sequential lineup. Similarly, more false memories may be made by witnesses who make absolute judgments in a sequential lineup because more time is spent examining the features each individual face.

If the memory alteration hypothesis is correct, it is important to present suspects in a way that does not alter an original memory for a perpetrator. The ideal lineup type would increase the number of true-rejections, reduce the number of false-selections, and, perhaps most importantly, protect against the alteration of memory for the event so that future identification attempts will result in accurate identifications. Thus, if a false accusation is made, it can be corrected as long as the witness still has intact memory for the face of the perpetrator.

The Present Study

The study will use a two stage memory-test process proposed by McCloskey and Zaragoza (1985) originally intended to test the memory alteration hypothesis, and later utilized

by Ceci, Ross, and Toglia (1987) to examine suggestibility in children. This memory test was proposed to advance the knowledge of suggested and altered memories beyond what standard recognition tasks can provide. In standard recognition tests for suggested memories, to test recognition for an item after the introduction of misinformation, participants are asked to choose between the suggested (misinformed) item and the original item. For example, in a lineup scenario, participants would be asked to choose between an incorrect suspect they had previously identified and the actual perpetrator of the crime. However, this memory test may not fully measure what it is purported to test. If participants did not encode information about the initial item or were responding to social pressure to show commitment to their previous choice, the standard test would still indicate that memory alteration has occurred.

In order to account for these possible confounds, McCloskey and Zaragoza (1985) recommended that an additional memory test is needed, the so-called "modified" test. In this modified memory test, participants are asked to choose between the original item and a completely novel item. For example, witnesses would be asked to choose between the actual perpetrator of a crime and a completely new suspect who had not been the object of prior misinformation. This test would truly examine whether the participant recognizes the actual perpetrator. If their memory for the perpetrator has not been altered by misinformation, witnesses should select the actual thief at a higher rate than the novel suspect. This could occur even if witnesses favor the original suspect during the standard test. If witnesses' memory had been altered, they would not recognize either the actual perpetrator or the novel suspect and would have to guess between the two options. In short, the modified test allows the disentanglement of social and cognitive factors in memory errors and helps reveal true alteration of memory.

Using this technique, McCloskey and Zaragoza (1985) found recognition performance in the modified condition was markedly better than in the standard condition. As could be deduced from their design, this means that even if participants were more likely to select the suggested item, their memory for the original item was at least somewhat intact. This suggests that the memory alteration hypothesis may not be correct and instead true memory for an event may coexist alongside suggested information. However, Ceci, Ross, & Toglia (1987) only found this to be partially true when the same technique was used with children. In their results, memory performance in the modified condition (which yielded 71% correct responses) was still better than in the standard condition (52% correct). However, performance in a control condition in which participants were not exposed to suggested stimuli was still the best (87% correct). This implies that for at least some participants, exposure to suggestion did alter the underlying memory for the original item. If this had not been the case, children would have selected the novel item in the modified condition at rates similar to in the control condition.

The present study will use the two stage memory-test proposed by McCloskey and Zaragoza (1985) to examine three questions. First, can choosing someone from a lineup alter memory for the actual perpetrator? Second, can different lineup presentations (simultaneous, sequential, or elimination) protect against memory alteration? And finally, how does age influence memory alteration caused by viewing a lineup?

Method

Participants

There were a total of 229 participants. Children (n = 169, M = 8.80 years, SD = 2.87, range = 4 to 16 years) and adults (n = 57, M = 37.40 years, SD = 12.11, range = 18 to 66 years) were recruited from a local science museum (n = 214) and an after school program in up-state

New York (n = 15). Three participants did not report age. Children were given stickers as a gift for their participation. There were 131 female participants and 98 male participants. Due to the lack of diversity in the sample, race was collapsed into two categories: white and non-white. There were 176 white participants and 37 non-white participants, with 16 participants not identifying their race. Each participant was tested individually and all conditions were between subjects.

Procedure

Participants were approached on the floor of the science museum or during pick up at the end of an after school program. Both adults and children were asked if they would like to participate in a memory study. Adult parents and caretakers were told briefly about the nature of the study and were asked to sign an informed consent document for any child participant. Participants were told that they were going to play a game in which they would witness a fake crime and then help identify the culprit. All participants were told they could stop playing the game at any time.

After consent had been obtained, participants were shown a 40-second video in which a blonde female steals a messenger bag containing a laptop. During the video, a lone man is seen working on his laptop, which he puts into a messenger bag, and then stands up to engage in conversation with another man. While they are conversing, a woman enters the frame, sits down next to the bag, and surreptitiously places the bag over her shoulder. She then walks away.

Participants were then told to imagine that they were the key witness to this crime and were being asked to help with the police investigation to identify the thief. As a first step in the investigation, participants were told to report everything they remembered from the video. If a participant did not mention the crime or the female thief during their free recall, the research

assistants were trained to gradually prompt the participant until they mentioned what the woman in the video was doing. After the participant reported having no other relevant memories from the video, they were asked to answer a few demographic questions (birthday, gender, and race).

Time 1 Lineup

Next, participants were shown a five person, target-absent lineup. The fillers in the lineup were all blonde, white women with some resemblance to the thief from the video. Color photograph "head shots" were used of all of the suspects. An example of this lineup can be seen in Figure 2. The lineups were shown on a computer screen and participants were asked to point to the suspect they believed was the thief if she was in the lineup. Once an identification or rejection occurred, the research assistant moved on to the next stage of the study. Participants were not required to make a selection from the lineup, and 47.6% correctly rejected all suspects in the initial lineup (n = 109). Participants were randomly assigned to one of three lineup presentation conditions (simultaneous, sequential, or elimination) and were asked to pick the perpetrator out of the lineup. The study utilized a between-subjects design, with each participant only viewing one lineup type.

Simultaneous. In the simultaneous condition (n = 84), participants received the following instructions:

> Earlier, you saw a video of a bag-snatching. The police have a few suspects for the crime. I'm going to show you pictures of the suspects. Think back to what you remember from the video, and tell me if any of the people I show you is the *same* person who stole the bag in the video. Keep in mind that none of the pictures I show you may be the same person from the video. If you don't see the

> thief from the video, it's okay to say "no." Does that make sense? Is one of these people the thief from the video?

In this condition, all photographs were shown at one time, that is, simultaneously. The order of the photographs was randomized and all pictures were shown in a single row.

Sequential. In the sequential condition (n = 75), participants received the following instructions:

> Earlier, you saw a video of a bag-snatching. The police have a few suspects for the crime. I'm going to show you pictures of the suspects one at a time. Think back to what you remember from the video and tell me if the person I show you is the *same* person who stole the bag in the video. Keep in mind that the picture I show you may not be the same person from the video. If you don't see the thief from the video, it's okay to say "no." If you say "no," we'll move on to the next picture. Does that make sense? Is this the person the thief from the video?

In this condition, all photographs were shown *one at a time*, that is, sequentially. The order of the photos was randomized. Participants were not allowed to look back at previous photos and were not told how many photos would be in the spread. If the participant indicated that the thief was in the picture, the researcher stopped showing suspects and moved to the next stage of the study. If a participant saw all photos and did not select anyone, the research assistant said that the police had no more suspects and advanced the participant to the next stage of the study. Note that participants were not told how many suspects would be shown, to avoid response bias.

Elimination. In the elimination condition (n = 70), participants received the following instructions:

> Earlier, you saw a video of a bag-snatching. The police have a few suspects for the crime. I'm going to show you pictures of the suspects. Think back to what you remember from the video, and tell me which of the people I show you looks the most similar to the person who stole the bag in the video. Does that make sense? Look at these photos. Which of these people looks *the most* like the person from the video?

This constituted a relative judgment for this lineup procedure. Once a picture was selected, the other photos were removed and the participant was told the following:

> Look at this person you chose. Is this the *same* person as who was in the video? If it's not the thief from the video, it's okay to say "no." Is this the person from the video?

Time 2 Lineup

After making a selection from the initial lineup, there was then approximately a twenty minute delay before the second session began. At the science museum, participants were asked to wander around the museum for twenty minutes and then come back to look at some more photographs and test their memory again. Ten participants did not return for the second session for a return rate of 95.63%. At the after school program, children were returned to their program's regular activity, and a research assistant approached them again after twenty minutes. All children from the after school program returned for the second session. The final participant total was 219. The average delay between the two sessions was 26 minutes (SD = 14 minutes).

After the participants returned, they were told the police had two suspects for them to look at. They were shown the two-person memory test and asked which of the suspects was the thief from the video they had watched earlier that day. This second lineup was designed to test

true and false memory for the initial event and the influence of prior lineup experience. Participants were randomly assigned to one of three memory test conditions: (a) a standard memory test, in which participants were shown their selection from the original lineup (an erroneous stimulus given that the original lineup did not include the actual thief) and the actual thief from the video ($n = 84$, referred to as the "standard" method), (b) a modified memory test, in which participants chose between the actual thief from the video and a completely novel face that had not appeared in the original lineup ($n = 69$, the "modified" method from McCloskey and Zaragoza, 1985), and (c) a control method, in which participants chose between their selection from the original lineup and a novel face ($n = 66$, the "control" method).

In all three conditions, if participants did not want to make a selection, they were told to make their best guess. If during the first session participants did not select anyone from the lineup, during the second session they were randomly shown a face from the first lineup as a stand-in for their original choice. This was done as participants may still have memory for the faces from the original lineup, even if they chose not to identify a particular suspect. However, memory traces for the original suspect may be weaker for participants who did not make an identification of that suspect. Thus, the data were analyzed both with and without these participants. Once participants had completed this task, they were debriefed, given a sticker in appreciation for the participation, and given a brief lesson about memory and police lineups.

Results

The results were examined in three stages. First, the choices during the first lineup were studied to determine correct rejection rates (i.e., the number of times that participants correctly identified that that the thief was not present in the lineup). Second, the likelihood of selecting someone from the first lineup during the second session was calculated (referred to as

"commitment" to the original suspect). The chance of choosing an original suspect is of interest, as during a real police investigation identifying the same suspect multiple times may reinforce police suspicions. In this study this is particularly important as identifying someone from the original lineup was always a false identification, and commitment to that identification during a second lineup may improperly sway the police, prosecutor, or jury. Furthermore, commitment to the original (but incorrect) suspect is an indication that viewing the first lineup may have had a suggestive effect on later choices. Finally, the likelihood of a correct identification of the thief was also examined.

Time 1 Lineup

Participants were randomly assigned to three different target-absent lineup conditions during Time 1. The correct response would be to reject all suspects. The percent of participants who chose each suspect were: 10.9%, 9.2%, 5.2%, 7.9%, and 19.2%. No difference was found in performance during the second lineup session based on which suspect was chosen during the first lineup.

Almost half of participants (47.6%) did not make a selection during Time 1. Figure 3 shows the number of participants who selected someone from the Time 1 lineup compared to the number of participants who correctly rejected all suspects. A marginally significant difference for the correct rejection rate was found across the three lineup procedures, $\chi^2(2, N = 229) = 5.18$, $p = 0.08$ (Cramer's $\varphi = 0.15$). A significant difference was found between rejection rates in the sequential and elimination conditions, $\chi^2(2, N = 145) = 5.10$, $p = .02$ (Cramer's $\varphi = 0.19$). Participants in the sequential condition were more likely to correctly reject all suspects than those in the elimination condition (57% versus 39% of participants chose no selection, respectively). No significant differences were found between performances in the simultaneous

(46% no selection) and elimination conditions, $\chi^2(1, N = 154) = 0.96$, $p = 0.33$ (Cramer's $\varphi = 0.08$), or between the sequential and simultaneous conditions, $\chi^2(1, N = 159) = 1.89$, $p = 0.17$ (Cramer's $\varphi = 0.17$).

These results indicate that participants who viewed the sequential lineup were less likely to falsely identify a suspect. The sequential presentation encouraged participants to correctly make no identification, whereas participants in the other two conditions chose someone at a higher frequency. Participants in the elimination condition were particularly vulnerable to falsely identifying a suspect, despite previous research that suggests it protects against false identifications (Pozzulo & Lindsay, 1999).

Commitment to Original Suspect

Three different memory test methods were utilized during Time 2 (standard, modified, and control), and in each condition participants were asked to choose between two different suspects. Figure 4 displays the rates of choices during Time 2. The figure shows both correct identifications and false commitment to the suspect from the original lineup.

In order to make conclusions about the memory test during the second session, participants who made an identification during the initial lineup will be analyzed separately from participants who rejected all suspects. In all three lineup types, participants were allowed to correctly reject all suspects and 47.6% of participants did not choose anyone during this first session. The behavior of participants who made a selection is very different from those who did not, and it is possible their memory traces and alteration is also different. For example, participants who rejected all suspects during the first lineup may still have a strong memory for one of these original suspects during the second session. However, they may select the other face they are shown simply because they remember not identifying the original suspect the first

time. This decision would not be due to correct memory for the thief, but rather due a clear negative memory for the original suspect.

In order to explore the effect of suggestion on memory further, the first step is to examine the likelihood for participants to show commitment to a suspect from the original lineup (the "original suspect") during the second session. Even if the witness initially rejected all suspects, a confirmation of one of the suspects during a second viewing may provide confirmation to the police that their incorrect selection is indeed the real thief. Furthermore, selection of the original suspect could indicate memory for the actual thief has been altered and the participant believes the original suspect is the real culprit. Choosing one of the original suspects was only possible in two of the memory test conditions: standard and control.

Control method. The control memory test allowed participants to select between a suspect from the original lineup and a novel suspect they had never seen before. If participants made a selection during Time 1, they were shown a photograph of the suspect they had originally identified. If participants correctly rejected all suspects, they were randomly shown a face from the original lineup. Figure 5 shows the choices of participants shown the control method. The hypothesis was that participants would be more likely to select their original choice than the novel suspect, as they had a strong memory for the original suspect and may misattribute that memory to the crime.

This hypothesis was supported for participants who made an initial selection. Participants who made an initial selection were significantly more likely to choose the same suspect during the second lineup (75% in simultaneous, 100% in sequential, and 79% in elimination). There was no significant difference in choice across lineup presentations, $\chi^2(2, N = 35) = 2.56$, $p = 0.28$ (Cramer's $\varphi = 0.27$). However, participants who did not make a selection

during the first lineup did moderately differ by lineup type, $\chi^2(2, N = 31) = 5.65$, $p = 0.06$ (Cramer's $\varphi = 0.42$). Participants in the elimination condition were more likely to select the novel suspect (100%) than the suspect from the original lineup. Participants in the simultaneous and sequential conditions were not significantly more likely to select either the novel or original suspect (62% and 45% chose the novel choice, respectively).

No participants shown the control method had the option to correctly identify the thief and thus their best outcome would be to identify the novel suspect. Selection of the novel face would not provide confirmation as a repeated choice that could hold undue weight during the investigation. Only participants in the elimination condition who had not chosen someone during the first session, performed this way. All participants in this condition ($n = 7$) chose the novel suspect.

Standard method. The standard memory test forced participants to select between the thief from the video and a suspect from the original lineup. If memory alteration had occurred, the hypothesis was that participants would be significantly more likely to choose the original suspect as their memory trace for the thief had been altered by the initial lineup. Similarly, the memory trace for the false suspect may have been strengthened by identification, if not completely overwriting memory for the actual thief. Figure 6 shows the choices of participants in the standard condition.

No significant difference was found between lineup presentation for participants who made a selection during the first session, $\chi^2(2, N = 39) = 3.15$, $p = 0.21$ (Cramer's $\varphi = 0.21$). There was a significant difference between lineup presentations for participants who did not make an identification during the first lineup, $\chi^2(2, N = 45) = 8.63$, $p = 0.03$ (Cramer's $\varphi = 0.43$). Participants in the simultaneous condition were more likely to make a correct identification of

the thief (100%) compared to participants who viewed a sequential or elimination lineup (56% and 67%, respectively). These differences suggest that the simultaneous lineup may act as protective effect against altering memory for the initial event, as all participants (n = 15) who did not make an identification during the initial simultaneous lineup later went on to correctly identify the thief.

Standard and control. The chance of incorrectly identifying a suspect from the initial lineup can be examined by combining the results from the control and standard memory tests. In both methods, participants are given an option to choose someone from the original lineup.

Figure 7 shows the results when participants made a selection during the first lineup. There was no significant difference in selection across the three lineup types, $\chi^2(2, N = 74) = 4.40$, $p = 0.11$ (Cramer's $\varphi = 0.24$). Participants who viewed a sequential or elimination lineup were more likely to maintain their original choice (80% and 70% respectively). However, participants in the simultaneous condition were less likely to maintain their original choice and instead chose the other suspect about half of the time (52% of participants chose their original choice). This implies participants in the simultaneous condition may have stronger memory traces for the actual thief than participants shown the other lineup presentations. Despite initially identifying a suspect during the first lineup, they were less committed to this selection. Again, the results indicate that simultaneous lineups may act as a protective factor towards reducing maintained false identifications.

Figure 8 shows the results for participants who correctly rejected all suspects during the first lineup. There was a significant difference across the lineup types, $\chi^2(2, N = 76) = 7.26$, $p = 0.03$ (Cramer's $\varphi = 0.31$). Participants in the sequential condition were more likely to select someone from the previous lineup than participants in either of the other two conditions (48% of

participants in sequential versus 18% in simultaneous and 21% in elimination). This suggests that, even when a correct rejection was made during the first session, sequential lineups may reduce memory for the event but also may not introduce a strong memory trace for the misinformation; this may be a result of intense focus on each foil face individually in contrast to the other forms of lineup presentation where the foil faces are compared more relatively to each other. Alternatively, participants who saw an elimination or simultaneous lineup may remember the original suspect the best but also remember that they had not believed it was the thief during the first session. They may be showing commitment to this lack of identification.

Likelihood of original suspect commitment. A logistic regression model was estimated to predict the likelihood of selecting someone from the original lineup during Time 2. A number of variables that may be linked to suspect choice were included in the model: memory test method (standard or control), participant gender (male or female), participant race (white or non-white), age, time delay between Time 1 and Time 2, selection during Time 1 (selection or no selection), and lineup condition. An interaction between selection and lineup condition was also included as participants in the sequential condition were more likely to not make a selection during the first lineup.

The estimates of the raw scores of the predictor variables on original suspect commitment, standard errors, and odds ratios are displayed in Table 1. Results showed that memory test method was a significant predictor of selecting someone from the initial lineup instead of the alternative presented suspect. When given the choice of selecting the thief, the odds of incorrectly identifying a familiar suspect from the original lineup were 0.32 lower.

Participant race was also a significant predictor of commitment to the original suspect, with white participants 3.78 times more likely to incorrectly identify the original suspect than

non-white participants. Age was also a significant predictor. For each year increase in age, participants were 1.03 times more likely to incorrectly identify a familiar suspect. This means that older participants were more susceptible to the lineup's influence on memory, at least in terms of confidently reidentifying a previously seen suspect. In other terms, adults were more stable witnesses.

Finally, lineup type was also a significant predictor of commitment to the original suspect. The odds of incorrectly identifying someone from the original lineup were 0.24 times lower when the participant was in the simultaneous condition compared to participants in the sequential condition. Again, this suggests that the simultaneous lineup presentation may be a protective factor against memory alteration, whereas the sequential lineup may cause undue influence.

Correct Identification

The above results suggest that age, race, and lineup type can predict the likelihood of incorrectly identifying a familiar suspect. Can the same factors be used to predict the likelihood of correctly identifying the thief, despite potential influence from viewing an earlier lineup? Correct identification of the thief was possible in two of the memory test conditions: standard and modified. The results of the standard condition were previously discussed and suggested that the simultaneous condition may protect against memory alteration.

Modified method. The modified memory test allowed participants to select between the thief and a novel suspect. This method followed the strategy proposed by McCloskey and Zaragoza (1985) to test whether the memory alteration does occur following suggestive information. If memory for the thief has been altered, participants should correctly identify the thief at a reduced rate compared to if their memory for the thief still exists alongside their

memory for the original suspect. Participants displaying memory alteration would not recognize the thief and instead would have to guess between the novel suspect and the thief, and therefore would be more likely to choose the novel suspect than participants shown the control memory test. Figure 9 shows the results for participants given the modified memory test. No significant difference was found between lineup types for participants who had made a selection during the initial lineup, $\chi^2(2, N = 42) = 2.33$, $p = 0.31$ (Cramer's $\varphi = 0.24$). Participants in all three lineup types correctly identified the thief at a higher rate than they misidentified the novel suspect (83% of participants in simultaneous, 100% in sequential, and 79% in elimination).

There was also not a significant difference found across lineup types for participants who had not made a selection during the first session, $\chi^2(2, N = 27) = 0.92$, $p = 0.63$ (Cramer's $\varphi = 0.61$). In the sequential condition, around half of the participants correctly identified the thief (46% in the sequential), with correct identifications slightly higher in the other two conditions (62% simultaneous and 67% elimination). These results suggest that participants who did not make an identification during the first lineup may be demonstrating memory alteration, as their likelihood of being correct is around chance.

Modified and standard. The chance of correctly identifying the thief can be examined by combining the results from the modified and standard conditions. In both conditions, participants are given an option to choose the thief. Figure 10 shows the results when participants had made a selection during the first lineup. There was no significant difference across all three lineup types, $\chi^2(2, N = 81) = 1.87$, $p = 0.39$ (Cramer's $\varphi = 0.15$). When a previous selection had been made, the rate of selecting the thief was higher than selecting the novel suspect despite lineup condition

Figure 11 shows the results when participants had correctly rejected all suspects during the first lineup. There was a significant difference across the lineup types, $\chi^2(2, N = 72) = 7.42$, $p = 0.02$ (Cramer's $\varphi = 0.32$). Participants in the simultaneous condition were more likely to correctly identify the thief (87%) as opposed to participants in the sequential condition, who were only at chance (52%) for correct identification. This suggests that, even when a correct rejection was made during the first session, sequential lineups may reduce memory for the event and result in guessing. In contrast, simultaneous lineups may be particularly protective against memory alteration. Participants in the elimination condition did not differ significantly from the other two lineup types (67% correct).

Likelihood of correct identification. A logistic regression model was estimated to predict the likelihood of correct identification of the thief during the second lineup. The same predictor variables were used in this model as in Model 1. The estimates of the raw scores of the predictor variables on correct identification, standard errors, and odds ratios are displayed in Table 2.

Results indicated that age was a significant predictor of correct identification. For each year increase in age, the odds of a correct identification were 0.97 lower. This is in addition to finding previously that older participants are more likely to commitment to an incorrect identification of the original suspect. This suggests that the misinformation effect may be the strongest for adult participants. Adults are more likely to remember and identify the original suspect's face and thus are less likely to correctly identify the thief. It is possible that children are simply guessing at random during both lineups and thus are less likely to select the original suspect while also more likely to correctly identify the actual thief. In contrast, adults may have better memories for the original suspect and this makes retrieval of the memory trace for the

actual thief more difficult. Thus, despite having better memories, adults perform less accurately during the second session.

Selection was also found to be moderately significant, with the odds of a correct identification 0.13 times lower for participants who had not made a selection during the first session. The interaction between lineup type and selection was also found to be significant. Participants in the simultaneous condition who made a choice during the first lineup had 14.10 times greater odds of making a correct identification than participants in the sequential condition who had not made a choice. While not making a selection during the first week tended to have a protective effect on correct choices, the sequential condition altered memory enough to distort this protection. Instead, even participants who had made a choice during the initial simultaneous lineup performed more accurately than participants who correctly rejected all suspects in the sequential condition. There was no significant effect of the elimination condition.

Discussion

The present study was designed to test whether making a selection from a target-absent lineup could alter memory for the actual perpetrator. This study also attempted to examine whether a particular lineup presentation could protect the memories of both child and adult witnesses while also reducing the level of false identifications. To examine these research questions, the study used a version of the modified memory alteration test proposed by McCloskey and Zaragoza (1985) and subsequently adapted to study children by Ceci et al. (1987). Participants were first asked to select a suspect from a target-absent lineup, with "no selection" a possibility. Three lineup presentations were used: simultaneous, sequential, and elimination.

Then, after a delay, participants were shown a two-person memory test and asked to make a second identification of the perpetrator. The faces in the second lineup were either an incorrect suspect from the original lineup, the actual thief, or a novel face. These choices mirrored the memory tests used by McCloskey and Zaragoza (1985). In the standard memory test participants were shown their original choice and the actual thief; in the modified memory test, participants were shown the actual thief and a novel face; and in the control memory test participants were shown the actual thief and their original choice. The results were analyzed to determine if memory alteration occurred (shown by the likelihood of participants to select their original choice in the three conditions), whether one of the three types of lineup presentation could act as a protective factor against memory alteration and false selections, and, finally, what role age of participant played in these lineup results.

As the first lineup was target-absent, the best performance by a participant would be to make no selection during the initial lineup and then choose the thief (when presented) during the second lineup. The most problematic performance would be for a participant to choose a suspect from the initial lineup and reidentify the same suspect during the second lineup session, as this could act as affirmation of the suspect's guilt to the police, prosecutor, and jury.

First, it is important to note that there were significant differences in performance between participants who (incorrectly) made a selection from the first lineup and participants who (correctly) rejected all suspects from this target-absent lineup. Participants who made a selection were more likely to maintain their choice during the second memory task, as long as they were shown their original choice. Participants who did not make a selection were more likely to choose the other option (there was one exception to this: when participants were in the sequential lineup condition). This "no selection effect" may indicate that not making an

identification is the biggest protection against memory alteration. Thus, the most protective lineup presentation would allow for witnesses to easily reject any foils without spending too much time encoding the faces of the suspects into their memory. For this reason, a relative judgment may actually be superior, as witnesses would spend more time comparing features of faces, rather than studying suspect's faces as a whole. These relative comparisons may create memory traces that are more independent of the actual thief and could make post-suggestion recognition of the thief's face easier.

However, the same relative judgments may also put the witness at risk for making a false identification during the first lineup. In this study, participants in the sequential condition were the least likely to make a false identification during the first lineup session. This supports previous research which has found that sequential lineup presentations are protective against false identifications, due to the absolute nature of the judgments they encourage (Steblay et al., 2011). In this way, the sequential lineup may be the most superior presentation type, as it is the most conservative approach in terms of protecting innocent suspects from false identification. However, our results indicate that the sequential presentation may not meet the other criteria for the best lineup (i.e., protects against memory alteration or source misattribution). The best lineup presentation would also need to have a lower rate of commitment to an original suspect and a higher rate of thief identification during a second lineup.

The elimination lineup presentation was proposed as a way to reduce false identifications while maintaining the level of correct identifications made by child witnesses. Some previous research has indicated that this was successful (Pozzulo & Lindsay, 1999), while other research suggests that the technique does not lower the number of false identifications that children make (Beresford & Blades, 2006). The present study found that the elimination procedure was

relatively unexceptional during the memory tests in the second session . However, participants in this condition made the highest number of false identifications during the first session, suggesting that the elimination procedure does not reduce guessing amongst participants. This could be due to the lack of strong cautioning instructions in contrast to the instructions used by Pozzulo and Lindsay (1999).

Of particular interest in the present study were factors that could predict whether participants show commitment to an original suspect from the first lineup during the memory test. Commitment to an incorrect suspect may be problematic as multiple identifications of the same suspect may improperly sway the police, prosecutor, or jury. This is particularly problematic if identification of the wrong suspect also alters the witness's memory for the real perpetrator's face. There were two memory test conditions in which participants were able to identify an original suspect: control and standard. A logistic regression model was conducted to estimate the likelihood of choosing the original suspect in these two conditions.

Selection was the most significant factor in determining the likelihood of choosing an original suspect. If a participant selected someone during the first lineup, they were more likely to maintain that choice. Participants who did not make a selection during the first lineup were later more likely to choose someone other than the original suspect. One potential explanation for this result is that participants may still remember the face of the original suspect, but also remember that they did not choose this suspect as the thief. When tested later, these participants then show a commitment to their non-identification of that original suspect.

Furthermore, when the actual thief was an option during the second lineup, participants were also less likely to show commitment to the original suspect. This may provide evidence contrary to the memory alteration hypothesis proposed by Loftus (1979). If alteration of

memory had occurred after viewing the lineup, participants would not show a preference for the actual thief. Even though participants were more likely to select the misinformation (i.e. the original suspect) when shown both the standard and control memory tests, they were slightly less likely to do this when they had the option to choose the true information (i.e. the actual thief) as opposed to unfamiliar information (i.e. the novel face). This preference indicates that, although memory for the original face may be more difficult to retrieve than the suggested information, it does remain unaltered and thus may coexist alongside the misinformation.

The regression model showed that the simultaneous lineup presentation acted as a protective factor against showing commitment to the original suspect. Participants who had been shown a simultaneous lineup were less likely to select the original suspect than participants who had been shown the sequential lineup. While the sequential lineup did initially protect against false identifications, the results showed that it became less protective during the memory test. In fact, even participants who did not make a selection from a sequential lineup were more likely to later identify the original suspect than they were the actual thief. Conversely, participants in the simultaneous lineup who did make an initial choice (the most at-risk group for a second false identification) were less likely to maintain it during the second session than participants in other lineup conditions. This is the best behavior pattern that could be made after an initial false selection, as changing choices during a second lineup suggests the witness may not be reliable..

Based on these findings, in order to decrease commitment to an incorrect choice or the alteration of memory due to suggestion (as measured here by the likelihood to select someone from the initial lineup as opposed to the actual thief), the simultaneous lineup is the best choice, while the sequential lineup is the most problematic. The elimination lineup presentation falls

somewhere in between, with poor performance when a selection was made, but accurate performance when a selection was not.

Interestingly, this study found a significant race effect, with non-white participants less likely to show commitment to the original suspect. Instead, non-white participants were more likely to select either the novel suspect or the actual thief, judgments that could protect against false convictions. This is contrary to previous research which shows that witnesses are better at identifying faces of the same race (Gee, 2000; Smith, Stinson, & Prosser, 2004). However, this result may instead indicate that non-white witnesses are less stable than white witnesses when identifying white faces. Non-white participants may have weaker memory traces for the original suspect, and thus did not show a commitment to that identification. Unfortunately, one limitation of this study is that only target-absent lineups made up of white faces were used during the first session. It is unknown whether this race effect would remain after a target-present lineup or with the use of non-white faces

Finally, there was a significant effect of age on the likelihood to select the original suspect during the second lineup. Older participants were more likely to choose the original suspect than younger participants. This may be due to developmental reversals in memory, which suggest adults are may be more susceptible to suggestion when the information is stereotypical or gist-based (Brainerd, Reyna, & Ceci, 2008). In this study, adults may have formed stereotypical encodings of the original faces and thus created deeper memory encodings for the faces in the initial lineup than younger participants. Due to these deeper encodings, adults may have been more likely to remember the face of their original choice and maintain it. This developmental reversal may support McCloskey & Zaragoza's (1985) argument against the memory alteration hypothesis. Their argument claimed that participants without strong

encodings of the initial event may be more likely to incorporate suggestion into their memories than participants with an initial strong encoding. Adults may have difficulty remembering what the thief from the video looked like, just as children do, but adults may also better remember what choice they made due to stereotypical encoding. This may cause adults to show commitment to their choice more than children. This result is also supported by previous research examining the effect of multiple lineups on selection, in which adults were found to be more likely to maintain their choice then children (Parker et al., 1986; Gorenstein & Ellsworth, 1980).

In addition to examining commitment to the original suspect, this study also looked at which factors predicted the likelihood of a correct identification of the thief during the second session. There were two memory test conditions in which participants were able to correctly identify the thief: modified and standard. Regardless of behavior during the first session, the correct identification of the thief during the second session would increase true identifications and could protect against false convictions. A logistic regression examining the likelihood of correctly identifying the thief was utilized.

Selection during the first session was a moderate predictor of correct identification. In contrast to conclusions drawn by previous lineup research, this result suggests that participants who made a selection during the first target-absent lineup may actually have better memory than participants who refrained. Participants who made a selection were both more likely to show commitment to their choice and correctly identify the thief; this indicates that they are better able to recognize both the original suspect and the thief than participants who did not make an initial selection. It is possible that participants who refrain from identifying a suspect do so because their memory trace for the actual perpetrator is weaker to begin with.

Correct identification was predicted by a significant selection x lineup type interaction. Participants who made a selection during the first lineup (typically the most suggestive behavior) but were shown the simultaneous lineup were more likely to correctly identify the thief than participants who did not make a selection (typically the most protective choice) but were shown the sequential lineup. This suggests that, again, even in the most ideal circumstances, the sequential lineup may not protect against distortion of memory.

Age was also a significant predictor of likelihood of correctly identifying the thief. Adults were shown to be less accurate during the memory test in addition to being more likely to incorrectly identify the original suspect. This may be because children are more likely to guess during a lineup, as suggested by previous research (Pozzulo & Lindsay, 1998). Although children are more likely to identify the thief during the memory test, they appear to have relatively weak memories for the original suspect and are less likely to show commitment to the original suspect. Child witnesses have been shown to guess more often when they are unsure (Akerman, 1981), thus decreasing their likelihood to maintain a wrong selection during a repeated lineup. In contrast, adults have stronger memories for the original suspect and thus may be more susceptible to the misinformation effect and fail to correctly identify the thief. However, one limitation of this study was a small number of participants at different stages of the lifespan. Additional participants would allow for more conclusions to be drawn about the protective effects of lineups for different age ranges and to determine whether adults are more susceptible to misinformation during a lineup scenario.

It is important to note that there was not a predictive effect of memory test on likelihood to make a correct identification. There was no significant difference in the number of correct identifications between the standard and modified memory tests. If memory alteration had

occurred, participants would be less accurate when shown the original suspect as an alternative compared to when participants were shown the novel suspect. This lack of a significant result suggests that it is likely participant's memories have not been altered.

Further research will need to be done to study the memory alteration hypothesis in greater detail and explore the suggestive effect of lineups on memory in both children and adults. While this study showed no overwhelming evidence for memory alteration after viewing a lineup, support was found for a significant misinformation effect, especially in adults. Of particular future interest is the unique finding that participants who refrain from making an identification from a target-absent lineup may actually have weaker memory traces for the perpetrator than participants who make an initial incorrect identification. This result must be explored more to understand how best to present and use lineup identifications.

In addition, a study is planned which will utilize the modified memory test to discover selection differences when the initial lineup has not been shown. This study will compare the rate of selection of the original suspect over both a novel suspect and the actual thief in conditions when an initial suggestive lineup is shown versus when it is not. Introducing a no-suggestion condition will make the influence of lineup on memory even more clear, while still utilizing the paradigms adapted for this study. This future research will further the understanding of how viewing a lineup truly effects memory for the original event.

References

Ayers, M. S., & Reder, L. M. (1998). A theoretical review of the misinformation effect: Predictions from an activation-based memory model. *Psychonomic Bulletin & Review*, *5*(1), 1-21.

Beresford, J., & Blades, M. (2006). Children's identification of faces from lineups: The effects of lineup presentation and instructions on accuracy. *Journal of Applied Psychology*, *91*(5), 1102-1113.

Bowman, L. L., & Zaragoza, M. S. (1989). Similarity of encoding context does not influence resistance to memory impairment following misinformation. *The American Journal of Psychology*, *102*(2), 249-264.

Brainerd, C. J., Reyna, V. F., & Ceci, S. J. (2008). Developmental reversals in false memory: a review of data and theory. *Psychological Bulletin*, *134*(3), 343-382.

Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: a historical review and synthesis. *Psychological Bulletin*, *113*(3), 403-439.

Ceci, S. J., & Bruck, M. (1995). *Jeopardy in the courtroom: A scientific analysis of children's testimony*. American Psychological Association.

Ceci, S. J., Loftus, E. F., Leichtman, M. D., & Bruck, M. (1994). The possible role of source misattributions in the creation of false beliefs among preschoolers. *International Journal of Clinical and Experimental Hypnosis*, *42*(4), 304-320.

Ceci, S. J., Ross, D. F., & Toglia, M. P. (1987). Suggestibility of children's memory: Psycholegal implications. *Journal of Experimental Psychology: General*, *116*(1), 38-49.

Chance, J. E., & Goldstein, A. G. (1984). Face-recognition memory: Implications for children's eyewitness testimony. *Journal of Social Issues*, *40*(2), 69-85.

Dekle, D. J., Beal, C. R., Elliott, R., & Huneycutt, D. (1996). Children as witnesses: A comparison of lineup versus showup identification methods. *Applied Cognitive Psychology, 10*(1), 1-12.

Foley, M. A., & Johnson, M. K. (1985). Confusions between memories for performed and imagined actions: A developmental comparison. *Child development, 56*(5), 1145-1155.

Gee, G. C. (2002). A multilevel analysis of the relationship between institutional and individual racial discrimination and health status. *American Journal of Public Health, 92*(4), 615-623.

Goodman, G. S., & Reed, R. S. (1986). Age differences in eyewitness testimony. *Law and Human Behavior, 10*(4), 317-332.

Gorenstein, G. W., & Ellsworth, P. C. (1980). Effect of choosing an incorrect photograph on a later identification by an eyewitness. *Journal of Applied Psychology*, *65*(5), 616-622.

Leichtman, M. D., & Ceci, S. J. (1995). The effects of stereotypes and suggestions on preschoolers' reports. *Developmental Psychology*, *31*(4), 568-578.

Lindsay, D. S., & Johnson, M. K. (1989). The eyewitness suggestibility effect and memory for source. *Memory & Cognition*, *17*(3), 349-358.

Lindsay, D. S., Johnson, M. K., & Kwon, P. (1991). Developmental changes in memory source monitoring. *Journal of Experimental Child Psychology*, *52*(3), 297-318.

Lindsay, R. C., Pozzulo, J. D., Craig, W., Lee, K., & Corber, S. (1997). Simultaneous lineups, sequential lineups, and showups: Eyewitness identification decisions of adults and children. *Law and Human Behavior*, *21*(4), 391-404.

Lindsay, R. C., Pozzulo, J. D., Craig, W., Lee, K., & Corber, S. (1997). Simultaneous lineups, sequential lineups, and showups: Eyewitness identification decisions of adults and children. *Law and Human Behavior, 21*(4), 391-404.

Loftus, E. F. (1979). Reactions to blatantly contradictory information. *Memory & Cognition, 7*(5), 368-374.

Loftus, E. F., & Loftus, G. R. (1980). On the permanence of stored information in the human brain. *American Psychologist, 35*(5), 409-420.

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information into a visual memory. *Journal of Experimental Psychology: Human Learning and Memory, 4*(1), 19-31.

Marin, B. V., Holmes, D. L., Guth, M., & Kovac, P. (1979). The potential of children as eyewitnesses. *Law and Human Behavior, 3*(4), 295-306.

McCloskey, M., & Zaragoza, M. (1985). Misleading postevent information and memory for events: Arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology: General, 114*(1), 1-16.

Palmer, M. A., & Brewer, N. (2012). Sequential lineup presentation promotes less-biased criterion setting but does not improve discriminability. *Law and Human Behavior, 36*(3), 247-255.

Palmer, M. A., Brewer, N., & Weber, N. (2012). The information gained from witnesses' responses to an initial “blank” lineup. *Law and Human Behavior,36*(5), 247-255.

Parker, J. F., & Carranza, L. E. (1989). Eyewitness testimony of children in target-present and target-absent lineups. *Law and Human Behavior, 13*(2), 133-149.

Parker, J. F., Haverfield, E., & Baker-Thomas, S. (1986). Eyewitness Testimony of Children. *Journal of Applied Social Psychology*, *16*(4), 287-302.

Parker, J. F., & Ryan, V. (1993). An attempt to reduce guessing behavior in children's and adults' eyewitness identifications. *Law and Human Behavior*,*17*(1), 11-26.

Penrod, S., & Cutler, B. (1995). Witness confidence and witness accuracy: Assessing their forensic relation. *Psychology, Public Policy, and Law*, *1*(4), 817-845.

Pozzulo, J. D., & Balfour, J. (2006). Children's and adults' eyewitness identification accuracy when a culprit changes his appearance: Comparing simultaneous and elimination lineup procedures. *Legal and Criminological Psychology*, *11*(1), 25-34.

Pozzulo, J. D., Dempsey, J., Corey, S., Girardi, A., Lawandi, A., & Aston, C. (2008). Can a lineup procedure designed for child witnesses work for adults? Comparing simultaneous, sequential, and elimination lineup procedures. *Journal of Applied Social Psychology*, *38*(9), 2195-2209.

Pozzulo, J. D., Dempsey, J., & Crescini, C. (2009). Preschoolers' person description and identification accuracy: A comparison of the simultaneous and elimination lineup procedures. *Journal of Applied Developmental Psychology*, *30*(6), 667-676.

Pozzulo, J. D., Dempsey, J. L., & Gascoigne, E. (2009). Eyewitness accuracy when making multiple identifications using the elimination line-up. *Psychiatry, Psychology and Law*, *16*(1), 101-111.

Pozzulo, J. D., & Lindsay, R. C. L. (1998). Identification accuracy of children versus adults: a meta-analysis. *Law and Human Behavior*, *22*(5), 549-570.

Pozzulo, J. D., & Lindsay, R. C. L. (1999). Elimination lineups: An improved identification procedure for child eyewitnesses. *Journal of Applied Psychology*, *84*(2), 167-176.

Steblay, N. K., Dysart, J. E., & Wells, G. L. (2011). Seventy-two tests of the sequential lineup superiority effect: A meta-analysis and policy discussion. *Psychology, Public Policy, and Law*, *17*(1), 99-139.

Smith, S. M., Stinson, V., & Prosser, M. A. (2004). Do they all look alike? An exploration of decision-making strategies in cross-race facial identifications. *Canadian Journal of Behavioural Science*, *36*(2), 146-154.

Sutherland, R., & Hayne, H. (2001). The effect of postevent information on adults' eyewitness reports. *Applied Cognitive Psychology*, *15*(3), 249-263.

Wells, G. L. (1993). What do we know about eyewitness identification? *American Psychologist*, *48*(5), 553-571.

Wells, G. L. (1984). The psychology of lineup identifications. *Journal of Applied Social Psychology*, *14*(2), 89-103.

Wells, G. L., Small, M., Penrod, S., Malpass, R. S., Fulero, S. M., & Brimacombe, C. E. (1998). Eyewitness identification procedures: Recommendations for lineups and photospreads. *Law and Human Behavior*, *22*(6), 603-647.

Zaragoza, M. S., & Lane, S. M. (1994). Source misattributions and the suggestibility of eyewitness memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*(4), 934-945.

Table 1
Logistic Regression Model Predicting Likelihood of Choosing the Original Suspect

	Model 1		
Variable	*β*	*SE*	Odds
Intercept	0.46	0.52	1.58
Standard condition	-1.13**	0.42	0.32
Male	-0.54	0.42	0.58
White	1.33*	0.60	3.78
Age	0.03*	0.02	1.03
Time	-0.02	0.02	0.99
Selection	1.91**	0.71	6.77
Lineup (compared to simultaneous):			
Sequential	-1.44+	0.75	0.24
Elimination	-0.73	0.63	0.48
Interactions:			
Sequential X Selection	-0.29	0.99	0.75
Elimination X Selection	0.31	1.02	1.36

Note. $n = 219$. Two-tailed statistical significance levels are indicated by + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The effects shown for each variable are for when its value = 0. The variables age and time have been centered.

Table 2
Logistic Regression Model Predicting Likelihood of Correct Identification of the Thief

	Model 2		
Variable	*β*	*SE*	Odds
Intercept	-1.46**	0.54	0.23
Modified condition	0.62	0.40	1.86
Male	0.32	0.41	1.37
White	-0.37	0.56	0.69
Age	-0.03*	0.02	0.97
Time	-0.01	0.02	0.99
Selection	-2.06+	0.43	0.13
Lineup (compared to simultaneous):			
Sequential	0.25	0.67	1.29
Elimination	0.81	0.62	2.24
Interactions:			
Sequential X Selection	2.65*	1.29	14.10
Elimination X Selection	1.61	1.31	5.02

Note. $N = 219$. Two-tailed statistical significance levels are indicated by + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The effects shown for each variable are for when its value = 0. The variables age and time have been centered.

Figure 1. Screen captures from the video depicting the bag snatching. The photograph on the left shows the thief taking the bag. The photograph on the right shows a clear shot of the thief's face as she walks away.

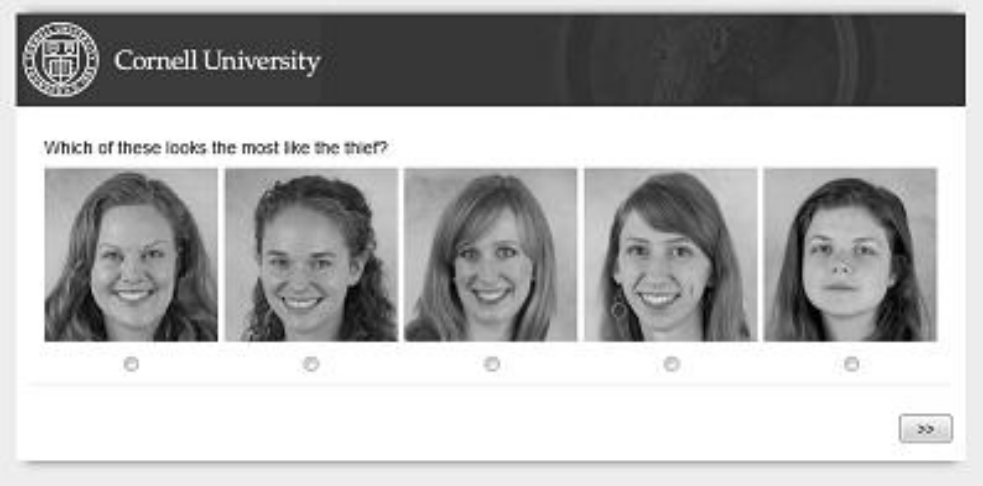


Figure 2. An example of the initial lineup in the elimination condition. The photographs were displayed in a random order.

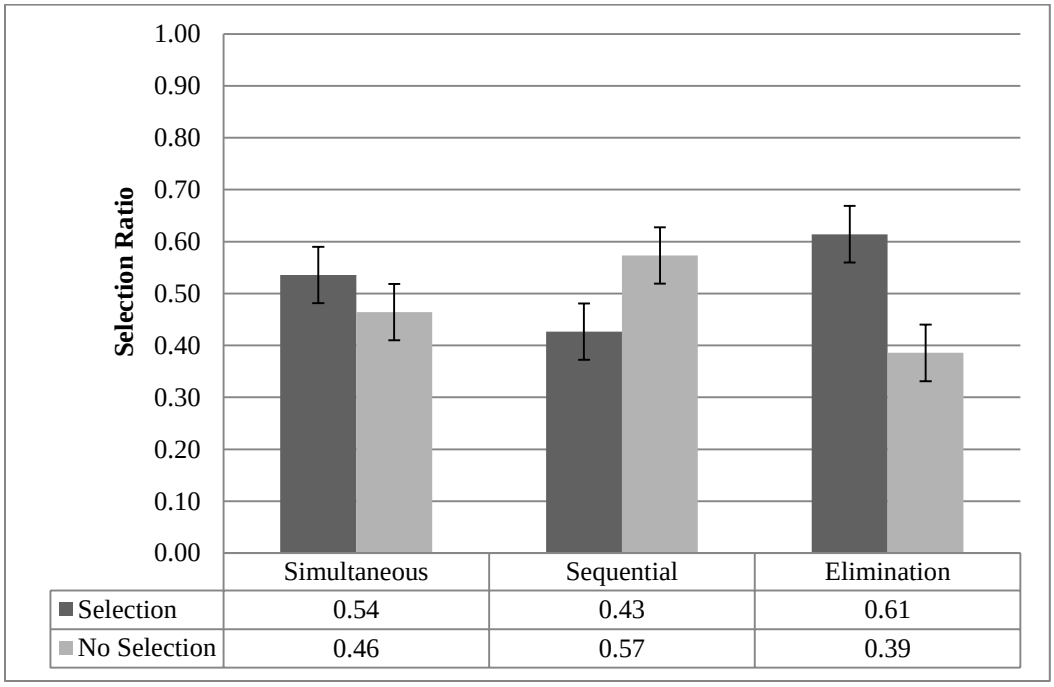


Figure 3. Rates of selection or no selection during Time 1 as a function of lineup condition. The correct response would be to reject all suspects and make no selection.

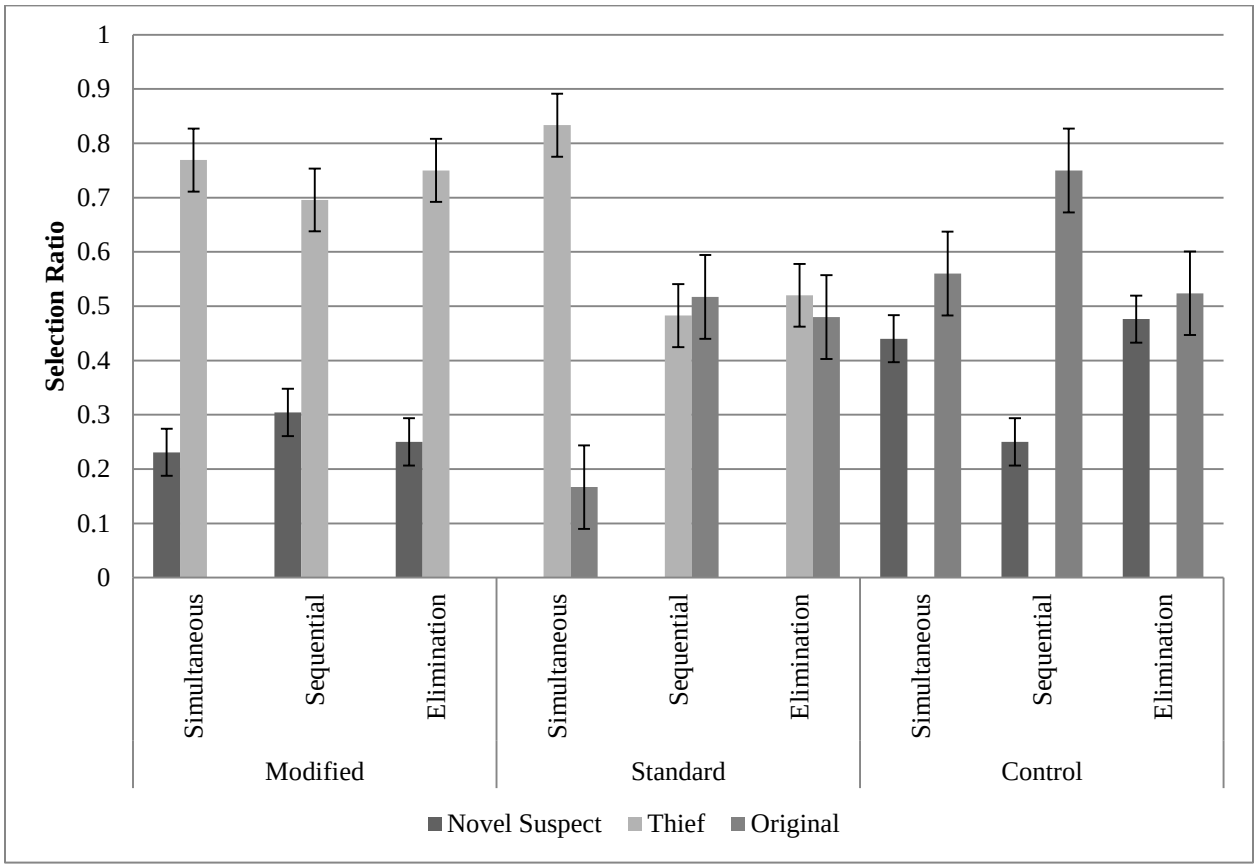


Figure 4. Selection choices during Time 2 as a function of Time 1 lineup condition and Time 2 memory test method.

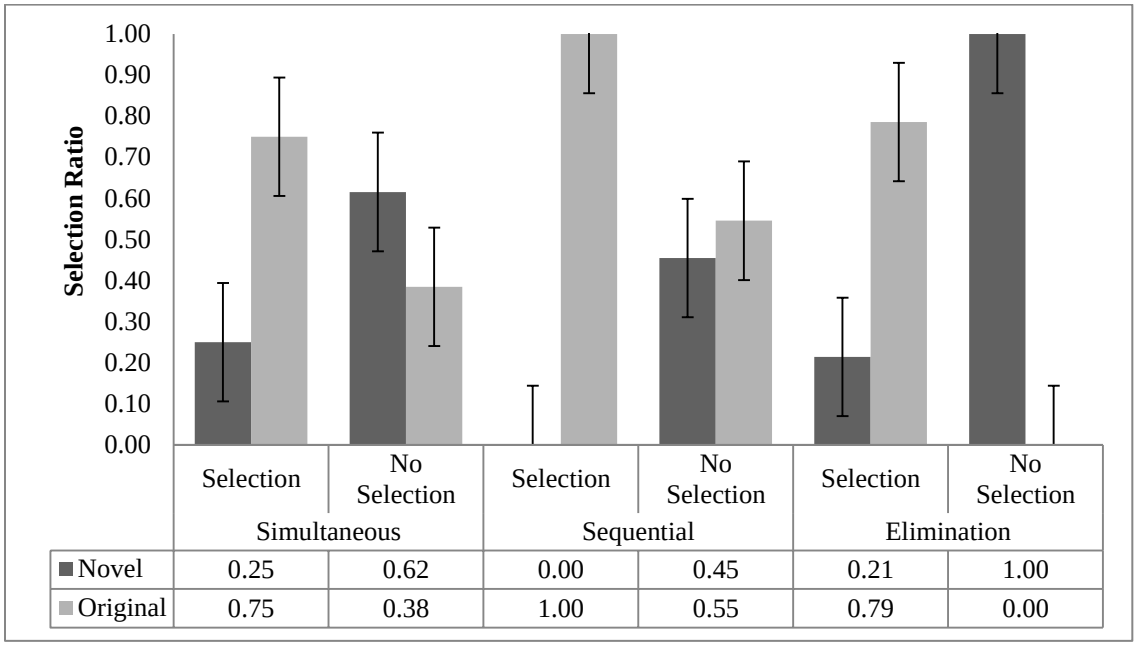
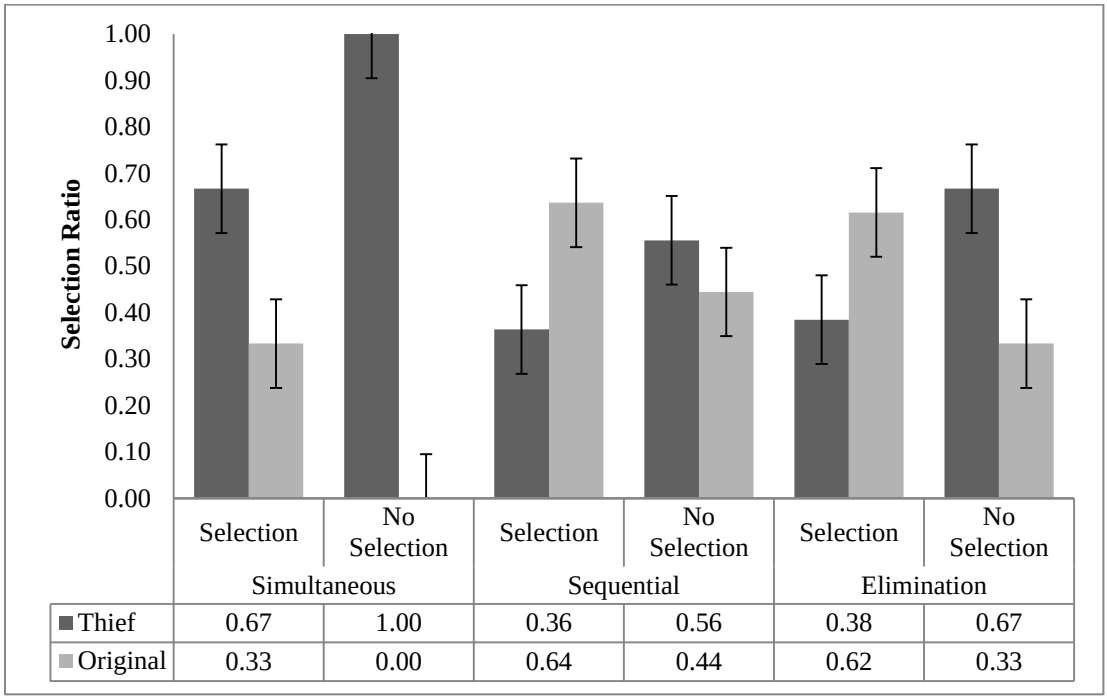


Figure 5. Time 2 selection rates for the control memory test method. In this condition, participants had the choice between a novel suspect and a suspect from the original lineup.



	Simultaneous		Sequential		Elimination	
	Selection	No Selection	Selection	No Selection	Selection	No Selection
Thief	0.67	1.00	0.36	0.56	0.38	0.67
Original	0.33	0.00	0.64	0.44	0.62	0.33

Figure 6. Time 2 selection rates for the standard memory test method. In this condition, participants had the choice between the actual thief and a suspect from the original lineup.

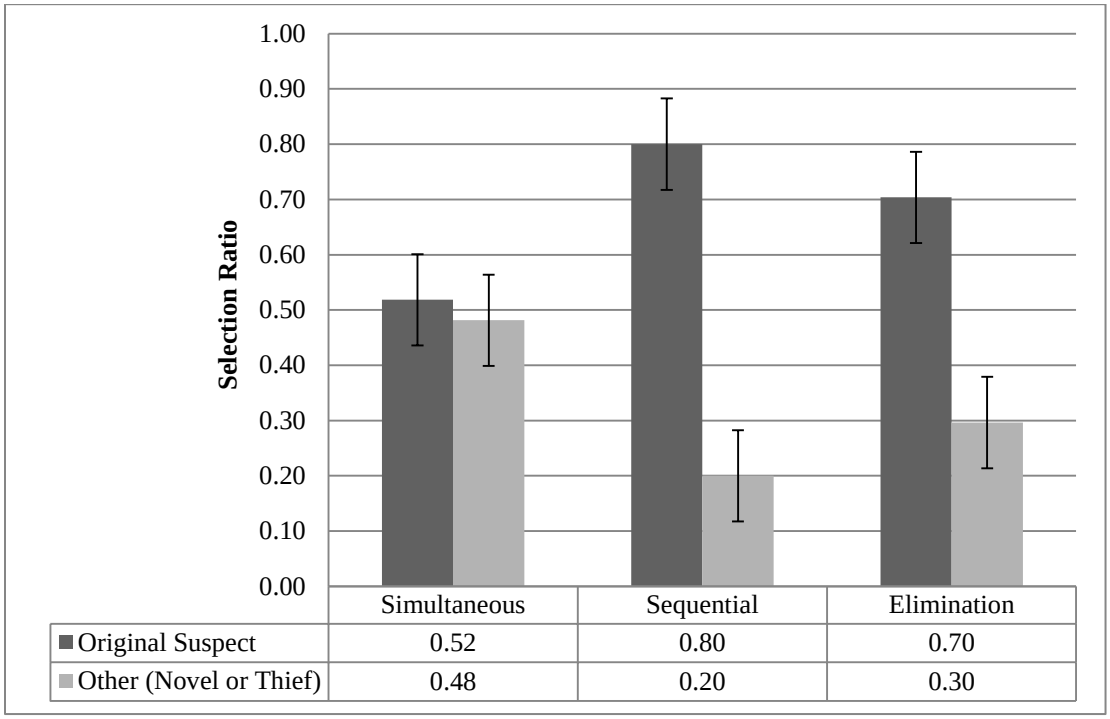


Figure 7. Decision rates between a suspect from the original lineup and a different suspect (either a novel suspect or the thief) as a function of lineup type. This figure only includes participants who made a selection during the first lineup.

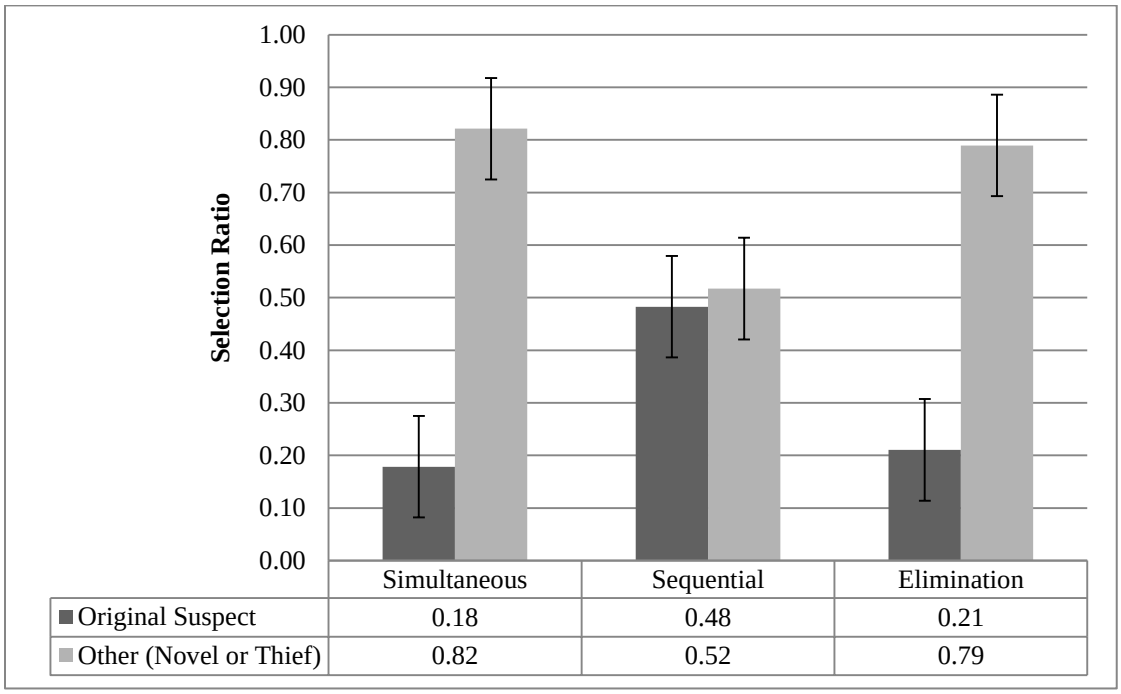
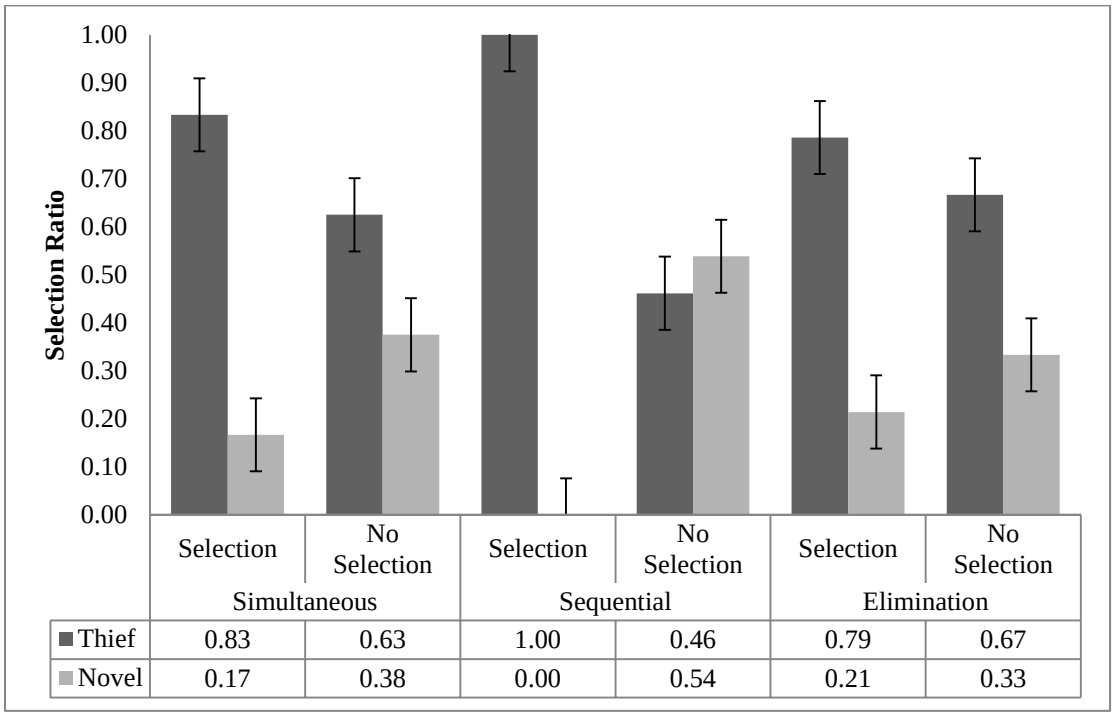


Figure 8. Decision rates between a suspect from the original lineup and a different suspect (either a novel suspect or the thief) as a function of lineup type. This figure only includes participants who correctly rejected all suspects during the first lineup.



	Simultaneous		Sequential		Elimination	
	Selection	No Selection	Selection	No Selection	Selection	No Selection
Thief	0.83	0.63	1.00	0.46	0.79	0.67
Novel	0.17	0.38	0.00	0.54	0.21	0.33

Figure 9. Time 2 selection rates for the modified memory test method. Participants in this condition had the choice between the actual thief and a novel suspect.

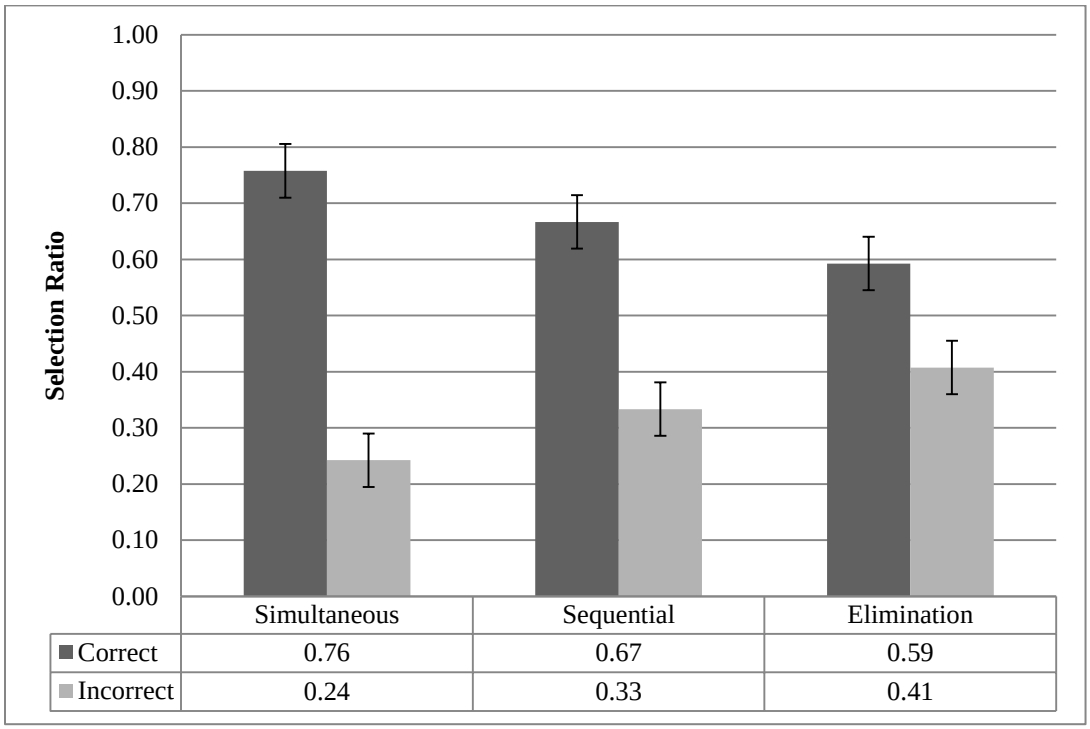


Figure 10. Correct identification of the thief as a function of lineup type. This figure only includes participants who made a selection during the first lineup.

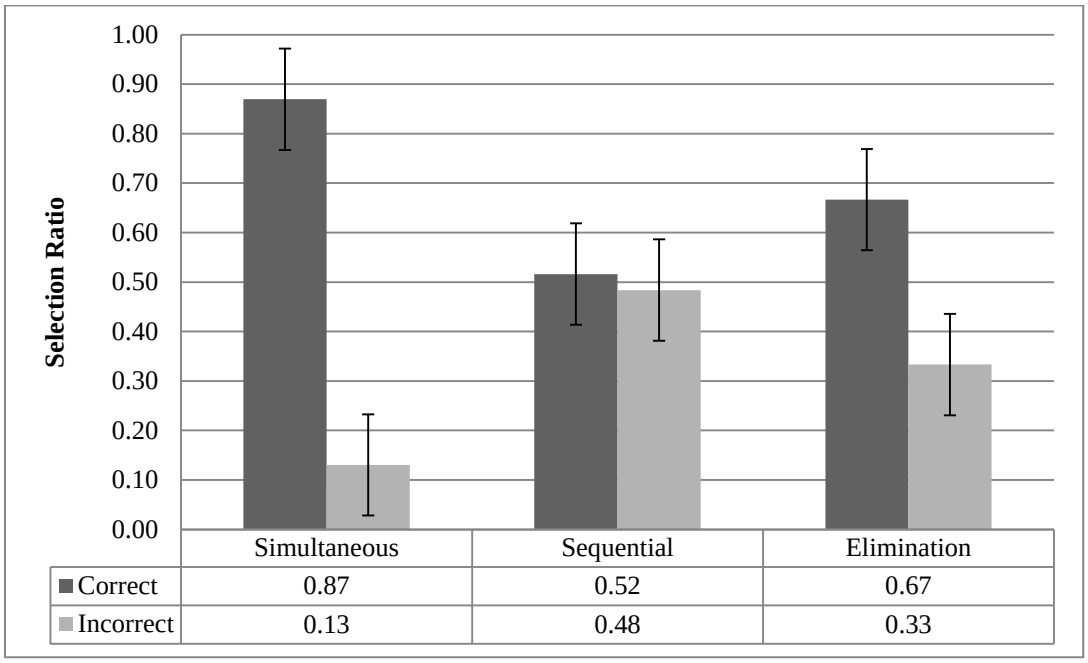


Figure 11. Correct identification of the thief as a function of lineup type. This figure only includes participants who correctly rejected all suspects during the first lineup.